TRANSLATION OF

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Description

The invention relates to a method of producing a spot-welded joint between two or more workpieces by using a rotating friction stud, more particularly a method of producing a joint wherein at least one workpiece has a thin-walled cross-section at the joint.

Various techniques for producing spot welds are already known. In the motor industry in particular, electric spot welding has been generally adopted for thin metal sheets.

In practice, however, these joints have been acceptable only in the case of sheet steel constructions. In the case of aluminium sheets, for example, the electrodes become unusable after only a few spot welds.

In the case of materials in increasing use nowadays, such as aluminium and magnesium or combinations thereof (aluminium-steel, magnesium-steel, magnesium aluminium) joints made by a rotating friction stud are a considerable improvement.

Considerable improvements in quality can be made, as regards strength, appearance and use of different material combinations. There is no need to prepare the material or use additional substances. The

service life of the tools is practically unlimited in the case of aluminium or magnesium, in contrast to electric spot welding.

The object of the invention is to develop a method of spot welding such that modern materials and different combinations of materials can be joined firmly, quickly, reliably and inexpensively.

According to the invention this problem is solved by the features in claim 1, wherein a rotating stud is inserted horizontally from the opposite side of the joint zone into one of the workpieces to be joined. The friction and pressure in the joint zone produce intense local heating which, together with the accompanying micro-deformation in the joint zone, tears open the passive layers. The pressure, as with pressure welding, results in a non-detachable connection between the workpieces.

The invention will be illustrated by the following exemplified embodiment and drawings.

Figs. 1 to 4 are cross-sectional views of two workpieces in successive phases of the production of a composite workpiece without a permanently present friction stud. Figs. 5 and 6 show the phases of production of a joint, using a permanently present friction stud 3. Figs. 7 and 8 illustrate improvements to the method, Fig. 7 showing a bead-cutting device 6 and Fig. 8 showing a clamp 7. Fig.

9 shows how a join can be made between more than two workpieces.

Fig. 1 shows two flat superposed workpieces 1 and 2, e.g. metal sheets or parts of hollow profiles for joining. The workpiece 2 must be fixed in position relative to the rotating stud, by a holding-up force. A rotating stud 3 is moved against the surface of the workpiece 1 and, while continuing to rotate, is firmly pressed against both workpieces without penetrating the workpiece 1. Since large amounts of energy are released in a short time by the friction, local temperature increases occur at the joint zone. The micro-deformation accompanying the heating and pressure at the surface causes the passive layers to break open at the joint zone 4. The high-energy active layers underneath can form bonds. The joining operation occurs under pressure and heat, similarly to the mechanism of pressure welding. The stud can then be either withdrawn from the workpiece 1 (Fig. 4) or can remain on the composite workpiece (Fig. 6).

In the case where the stud is a permanent unit of a welding device and is withdrawn (Fig. 4), the stud should preferably be made of a material having a higher melting point and good wear properties, since it will permanently be subjected to heat and friction. In addition to metals, therefore, ceramic materials are particularly suitable.

If the stud (Fig. 5) is used as part of the composite member, the connection to the drive unit must be releasable. The connection can be made e.g. by positive engagement (e.g. an internal hexagon) or by non-positive engagement (e.g. via clamping tongs). As in conventional pressure welding, the stud is bought against the sheet, rubbed against it, stopped and is additionally pressed if required (Fig. 5). The drive unit 8 is then uncoupled from the welded stud and retracted (Fig. 6).

Since the welding process always results in formation of a bead 5, the device can be equipped with a milling or turning means 6 for removing the bead (Fig. 7). The turning device can be fixed to and rotate with the friction stud or can be subsequently brought to the bead.

It may also be advantageous to secure the workpiece 1 by a clamp 7 (Fig. 8). The workpieces 1 and 2 cannot then come apart, and are therefore always pressed against one another sufficiently strongly, particularly in the region of the main heating at the periphery of the stud.

List of reference numbers

1	Workpiece 1
2	Workpiece 2
3	Stud
4	Joint zone
5	Bead
6	Bead-removal device
7	Clamp
8	Drive unit

C L A I M S

1. A method of producing spot-welded joints by means of a friction stud, characterised in that

a rotating stud (3) is inserted horizontally from the opposite side of the joint zone (4) into one of the workpieces to be joined without penetrating through it (Figs. 1 - 3),

in the joint zone the workpieces are firmly pressed together by the pressure of the stud and by axially fixing the facing workpiece (2) (Fig. 3),

the friction and pressure at the joint zone raise the temperature, and

after the welding operation the stud (3) is withdrawn (Fig. 4) or remains as a unit on the join (Figs. 5 and 6).

2. A method (Figs. 7 and 8) according to claim 1, characterised in that when a joint is made by means of a permanently present stud, the drive unit (8) is stopped shortly before the end of the welding process.

3. A device (Fig. 7) for the method according to claim 1, characterised in that a bead-turning device (6) co-operating with the stud removes the bead as it is formed.

4. A device (Fig. 8) for the method according to claim 1, characterised in that a clamp (7) prevents the workpieces moving apart.

5. A method (Fig. 9) according to claim 1, characterised in that a number of layers of workpieces are joined.